Homework #5: Springback

2.008 Design and Manufacturing II
Spring 2004

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Out: March 31st
Due: April 07th

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Problem 1

As demonstrated in class, springback is a problem which must be addressed when bending sheet metal. It occurs because there is always an elastic region (albeit, sometimes very small) within the sheet which wants to return to its original state after the bending operation. The springback of the bent sheet can be approximated using the expression

$$\frac{R_i}{R_f} = 4\left(\frac{R_i Y}{ET}\right)^3 - 3\left(\frac{R_i Y}{ET}\right) + 1 \tag{1}$$

where, as shown in Figure 1, R_i and R_f are the initial and final bend radii, Y is the yield strength and E is the elastic modulus of the metal, and T is the thickness of the sheet. As illustrated in Figure 1, the main effects of springback are that the final radius of curvature is larger than the initial radius and the final bend angle, α_f, is smaller than the initial angle, α_i. One approach to compensate for springback is to overbend the part (i.e., bend the sheet more than you want, hoping that it will spring back to the desired shape). Consider the bending of an aluminum sheet (Al 1200-O) with Y=5075 psi, E=10^6 psi, and T=1/8 in.

a) Which case will result in more springback: $R_i = 1$ in or $R_i = 2$ in? Why?

b) You are given a sketch of the setup for bending operation as shown in Figure 2. The target angle for the bend is 90° and $R_i = 2$ in. The process engineers aren´t certain how much of an angle to specify for the initial bend. After assuming that the length of the bent region of the sheet, s, stays constant and doing some geometry, they used Eq. 1 to find that the difference between the initial and final bend angles will be approximately 2°. What value should they specify for θ?
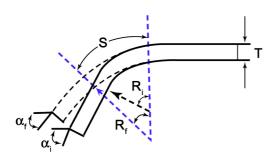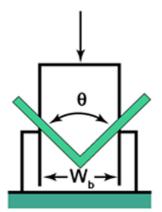

Figure 1: schematic of springback bending

Figure 2: sketch of V-die bending